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(54) **Method for manufacture of a sandwich panel, the sandwich panel obtained with it, and its application in the construction industry.**

(57) Method for the manufacture of a sandwich panel comprising a honeycomb core (10) and a skin sheet (14) on both sides of the core, whereby a glue of the reactive hot-melt type is applied to at least one end face (18) of the honeycomb core (10), and whereby next a skin sheet (14) is placed under a light contact pressure onto that end face (18), the temperature of the sandwich panel is adjusted to a value in the 120-160 °C range, to melt the glue after which the sandwich panel is cooled down to the ambient temperature.

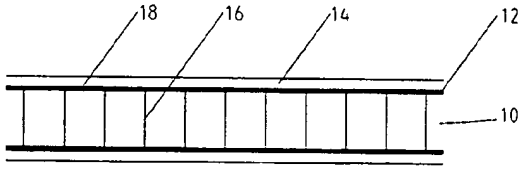

FIG. 1

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The invention relates to method for the manufacture of a sandwich panel comprising a honeycomb core and a skin sheet on both sides of the core.

The invention also relates to a sandwich panel manufactured in accordance with such a method and to its application in the construction industry.

Methods of the kind referred to in the preamble are known from the construction industry. Other applications are found in noise barriers, storage containers and in bodywork for freight vehicle construction. In the construction industry, for commercial and industrial buildings in particular, an aluminium sandwich panel is used wherein the core consists of an aluminium honeycomb and the skin sheets are also manufactured from aluminium. It has also been proposed to manufacture the honeycomb core not from aluminium but rather from an appropriate type of paper. Due to the honeycomb structure the finished sandwich panel then has adequate stiffness. Such sandwich panels with a honeycomb core of paper are known in a structure which is provided with a hardboard skin sheet. In this form they are used as interior doors and also as furniture panels, cladding panels and pallets and the like.

For joining together the skin sheets and the honeycomb core, use is generally made of so-called polyurethane glue systems in either one-component or two-component versions. The one-component polyurethane cures under the effect of moisture, is less expensive and the conditions of application are less critical than the two component polyurethane glue which has the advantage that its curing time can be adjusted more accurately.

In current practice, the sandwich panel is manufactured in such a way that the respective skin sheets are provided with glue, following which the sandwich panel is assembled by the honeycomb core being placed between the surfaces provided with glue.

The invention differs from the known practice in that a glue of the reactive hot-melt type is applied to at least one end face of the honeycomb, and in that a skin sheet is then placed onto that end face, the temperature of the sandwich panel is adjusted to a value in the 90-200 °C range and preferably in the 120-160 °C range, and the sandwich panel is then cooled down to the ambient temperature. The reactive hot-melt glue may be applied in liquid state to the contact face or faces of the honeycomb core, at a raised temperature and after the glue is applied and before the skin sheet is placed on, the glue can be brought to a solid state by cooling.

A panel produced in accordance with the novel method is illustrated in the accompanying drawing.

Figure 1 is a schematic representation of a panel in accordance with the present invention.

In Figure 1 the numeral 10 designates the honeycomb core. The cells 16 of the core 10 open into opposite end faces 18. A glue layer 12 on the end faces 18 of the core bonds the core 10 and the skin sheet 14 together.

The invention has advantages with respect to various problems and drawbacks associated with the known methods described above. First of all, the known methods are relatively expensive because a large part of the skin surface is provided with glue unnecessarily. In fact no more than approximately 5% of the skin surface comes into contact with an end face of the honeycomb core. On the assumption that the adhering surface area is rather larger than the contact surface area of the honeycomb core end face with the respective skin sheets, over 90% of the glue is applied unnecessarily.

Consequently an important advantage of the new method is the substantial saving in glue costs which may be made in accordance with the invention. Although glue systems of the reactive hot-melt type do cost more per kilo than the one or two component glue systems based on polyurethane, this is more than compensated for by the much lower glue consumption.

Furthermore, the method in accordance with the invention can give the advantage that when assembling the sandwich panel, the skin sheet or skin sheets may still slide relative to the honeycomb core without the glue becoming removed from the end faces of the honeycomb core and before adhesion is effected. If known polyurethane glues were used, such sliding cannot be permitted because the glue would be swept off the contact surfaces. The present method now avoids this problem due to the solid nature of the reactive hot-melt glue prior to the temperature rise and consequent adhesion which follows positioning of the skin sheet.

With the method proposed the further advantage is obtainable that it it possible to carry out a specific surface treatment to the near side faces of the skin sheets of the sandwich panel. The treatment is not worthwhile in known practice because the glue layer applied on the inner side of the skin sheets essentially counteracts its useful effect. Such a surface treatment may be aimed at improving the insulation quality of the sandwich panel.

A very important advantage is to be found in that the sandwich panel with a paper honeycomb core and metal skin sheets can be manufactured in accordance with the method of the present invention suitable for use in the construction industry as a panel which is mounted away from the vertical.

In contrast to other kinds of sandwich panel, the sandwich panel in accordance with the inven-

tion can be provided with flat skin sheets and does not need to be provided with any profiling to produce the required stiffness. On the one hand this gives an attractive visual appearance where used for exterior components. On the other hand the thermally effective surface of the sandwich panel is as such no larger than necessary which offers heat management advantages.

Unlike in the case of sandwich panel in accordance with the invention, in the case of the known sandwich panels undesired moisture can develop in the sandwich panel. This can pose problems with the types of glue used such that adhesion will not be effected.

Furthermore, environmentally it is an advantage of the sandwich panel in accordance with the invention that it lends itself very well to recycling without undesired residual products occurring. The core consisting of paper, cardboard or kraft paper is easy to break down and steel or aluminium suitable for re-use may for example be used for the skin sheets.

The sandwich panel manufactured in accordance with the invention thus offers the possibility of alleviating many problems to that it is particularly suitable for use as a construction industry panel where a high resistance to the effects of weather, in particular fluctuations of temperature, may be required.

In another aspect of the invention the method is characterised in that the skin sheet is placed on the end face of the honeycomb under a contact pressure in the region of approximately 0.01-0.3 MPa.

It is preferable for the temperature in the area of the contact surface of the skin sheet and the abutting end face of the honeycomb to be raised. It is then desirable for the sandwich panel to be heated inductively. Such a manner of heating achieves the effect that, due to adhesion forces, the glue positions itself in such a way around the contact surfaces of the skin sheet and the honeycomb core as well as in their immediate surroundings (this phenomenon is known in the art as fillet forming), that the optimum geometry of the glue joint that this achieves also produces an optimum adhesive action. Moreover, there is an energy advantage to be found in this because the raised temperature is essentially only applied where it is needed and desired. Following this heating stage the sandwich panel is cooled and is immediately suitable for further processing without the integrity of the sandwich panel being threatened. The passage of time causes further post-curing by "reticulation" or cross-linking of the glue.

The reactive hot-melt is preferably chosen from the group comprised of epoxy glues, polyurethane glues. In particular reactive hot-melt glue based on polyurethane is preferable in view of its lower costs. Hot-melt polyurethane glues are solid at room temperature and can be brought, reversibly, into a liquid state by heating to a melting point. Further heating above the melting point results in an irreversible change of the hot-melt polyurethane glue. Then, after cooling down to room temperature the glue provides the desired connection between the glued surfaces.

Claims

1. A method of forming a sandwich panel comprising a honeycomb core (10) with a skin sheet (14) on both sides of the core, characterised in that a glue of the reactive hot-melt type is applied to at least one end face (18) of the honeycomb core (10), and in that a skin sheet (14) is then placed onto said face and the temperature of the sandwich panel is adjusted to a value in the 120-160 °C range, after which the sandwich panel is cooled down to the ambient temperature.

2. A method according to claim 1, wherein the skin sheet (14) is placed on said surface under application of a contact pressure of approximately 0.01-0.3 MPa.

3. A method according to claim 1 or claim 2, wherein the temperature in the area of the contact surfaces of the skin sheet (14) and the honeycomb core (10) is raised.

4. A method according to any one of claims 1,2 or 3 in which the sandwich panel is heated inductively.

5. A method according to any one of the preceding claims wherein the reactive hot-melt is chosen from the group comprised of epoxy glues and polyurethane glues.

6. A method according to claim 5 wherein polyurethane is used as the reactive hot-melt.

7. A sandwich panel formed in accordance with the method of any one of claims 1 to 6 which is provided with metal skin sheets (14) and a honeycomb core (10) formed of a material from the group consisting of kraft paper, cardboard and paper.

8. The use of a panel formed in accordance with the method of any one of claims 1 to 6, the panel comprising metal skin sheets (14) and honeycomb core (10) of paper, cardboard or kraft paper as a building construction panel

and said panel being mounted away from the vertical.

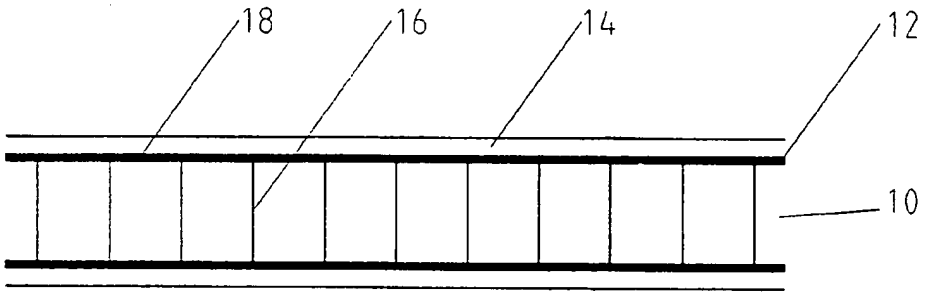

FIG. 1

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EUROPEAN SEARCH REPORT

Application Number

EP 92 20 1273

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
X	WORLD PATENTS INDEX LATEST Week 9048, Derwent Publications Ltd., London, GB; AN 90-358033 & JP-A-2 258 243 (HITACHI KASEI POLYM) 19 October 1990 * abstract *	1-8	B32B3/12 B32B15/12 E04C2/36
X A	US-A-3 817 808 (RONAN ET AL) * the whole document *	1-3,5,7 4,6,8	
A	US-A-4 461 796 (FUKAHORI ET AL) * the whole document *	1-8	
A	GB-A-2 104 839 (CIBA-GEIGY AG) * claims *	1	
A	EP-A-0 136 096 (FORD AEROSPACE & COMMUNICATIONS) * abstract; claims; figures *	1	
			TECHNICAL FIELDS SEARCHED (Int. Cl.5) B32B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	13 JULY 1992	DE JONGE S.J.P.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
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